



Technology Evaluation for Environmental Risk Mitigation Principal Center

Laser Coating Removal System Project for Shuttle

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Background

Several de-painting activities performed at Kennedy Space Center and other Centers are difficult to perform properly without damaging flight equipment in the process. Currently used methods include hand-sanding, bead-blasting. Additionally, currently used de-painting technologies utilize hazardous chemicals and/or produce hazardous waste that must be disposed of at a cost to NASA. Previous work on portable lasers by the Joint Group on Pollution Prevention proved that lasers can be user-friendly, low-hazard methods of de-painting of small areas and therefore potentially applicable for use on Shuttle flight-equipment.

Several NASA groups have shown interest in researching where these and other similar systems could be used in shuttle depot operations and flight ground service equipment operations.

Objective

The objective of this project is to demonstrate one or more portable laser technologies for use in several areas of shuttle processing operations, most notably, Orbiter processing. Current methods of paint removal on-Orbiter have been found to cause damage and contamination in the surrounding thermal protection system as a part of the process of shuttle tile repair and replacement after flight. Initially funding was sought from IES for an Orbiter project to demonstrate portable laser coating removal, but such funding was not granted. However, the Aging Vehicle Program did grant some funding for preliminary analysis of this system for use on the Orbiter. This is now considered a separate project and has been co-coordinated by NASA and Boeing. The initial objective is to show that these lasers can be used to remove several types of coatings and also determine how much of the underlying anodize layer can be left on the substrate while performing the de-painting work with a laser. Currently used methods include hand-sanding and bead-blasting. Test panels with various Orbiter-specific coating systems were prepared and then de-painted using the Portable Laser Coating Removal System and the amount of anodize left behind was determined both through conductive analysis and scanning electron microscope imagery. If the system can be initially qualified, a follow-on project was to be developed in 2006 - 2007 to qualify the technology for use on Orbiter and future space flight vehicles. Initial testing showed that using the fully hand-held technology could not guarantee that enough anodize could be left behind after de-painting, however when a 2-dimensional scanning head was used on a tripod or held in one position over the work area during use, nearly all anodize could be left behind while removing the primer coating.

Period of Performance

- August 2005 to March 2008

Stakeholders

Kennedy Space Center, Marshall Space Flight Center and Boeing. Opportunities exist and will be explored with other NASA Centers.

Benefits

- Reduction of hazardous waste streams in de-painting operations;
- Reduction of risk to workers of exposure to hazardous paint strippers;
- Reduction of time to prepare a tile cavity on the shuttle for a new tile;
- Reduction of risk for the Shuttle Thermal Protection System of contamination and/or damage due to the use of wet-sanding and/or bead blasting.

Document Status

- Completed field test plan for KSC – November 2006
- Completed field test plan for GRC – November 2005
- Completed draft of final report - April 2008
- International Traffic in Arms Regulations approval of final report – December 2008

Milestones

- Demonstration of portable laser technology on a variety of Orbiter, aircraft and structural substrates at Wright-Patterson Air Force Base for one-week in August 2004.

- Successfully completed two field-demonstrations of the technology at GRC and KSC. October 2005 & October-November 2006.
- Identified re-melt layer on substrates, performed tests to determine if lasers negatively affected the substrates in question. – November 2007.
- 120W laser was brought to Kennedy Space Center for a five-week demonstration. Interested parties from previous demonstrations were invited to view the technology and submit test panels. Air sampling was performed to determine exposure to chrome based coatings used specifically on the Orbiter. – October 2006.
- During the demonstration, the previously tested tile cavity mock-up, window retainer and a Cove-seal cover were displayed for observers to see previous test results. – October 2006.
- Space Shuttle Main Engine submitted two identical components to be stripped. One was stripped at Kennedy Space Center during the demonstration; the other was shipped to the laboratory of the laser manufacturer (Adapt Laser Systems) so that the 2-D scanning laser could be used to determine how that technology compared to the hand-held variety. November 2006.
- Weld lines and major surface areas of an Orbiter Scale Plate were successfully stripped during KSC Demonstration. As a result several flaws were detected in the component and actions have been taken by NASA to have these components repaired and/or replaced by the OEM. – November 2006.
- All originally planned field-tests were completed by July 2007. Analyses of these results were completed by October 2007.
- Secondary testing of re-melt layer and 2D scanning laser were completed by February 2008.
- Tested laser for surface preparation of titanium in May 2008.

Near-Term Goals

- Distribute final report to stakeholders.
- Follow up on stakeholder interest in the laser technology, not only for the applications demonstrated but for potential new applications as well (remediation of lead based paint on structures, confined space small scale stripping in missile silos, Non Destructive Evaluation, Corrosion Removal on Mobile Launch Platform & Crawler, Air Force Space Command launch structures, etc).
- Coordinate (as needed) Constellation program / Orbiter for titanium bonding testing and report on thermal protection system adhesion results.

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